Claims

That which is claimed:

1. A method of forming a conductive structure, comprising:

providing a substrate;

forming a lower conductive pattern on the substrate;

forming a barrier metal layer on the lower conductive pattern;

flushing the barrier metal layer with a gas that comprises a halogen group gas; and

forming an upper conductive layer on the barrier metal layer.

2. The method of Claim 1, wherein the gas further comprises a transition metal.

3. The method of Claim 1, wherein the gas further comprises helium, neon, argon, hydrogen, and/or nitrogen.

4. The method of Claim 1, wherein flushing the barrier metal layer comprises flushing the barrier metal layer at a temperature of about 200° C to about 500° C.

5. The method of Claim 1, wherein flushing the barrier metal layer comprises flushing the barrier metal layer with argon gas with a flux of about 500 sccm to about 10000 sccm and $TiCl_4$ gas with a flux of about 1 sccm to about 100 sccm at a temperature of about 300° C to about 450° C.

6. The method of Claim 1, wherein flushing the barrier metal layer

comprises flushing the barrier metal layer at a pressure of about 1 torr to about 100 torr for about 1 sec to about 10 minutes.

7. The method of Claim 1, further comprising:

degassing the barrier metal layer before flushing the barrier metal layer.

8. The method of Claim 7, wherein degassing the barrier metal layer comprises degassing the barrier metal layer using an inert gas at a temperature of about 200° C to about 500° C and a pressure of about 1 mTorr to about 100 Torr.

9. The method of Claim 7, wherein the barrier metal layer is a first barrier metal layer, the method further comprising:

forming a second barrier metal layer on the first barrier metal layer before forming the upper conductive layer.

10. The method of Claim 1, wherein the barrier metal layer is a first barrier metal layer, the method further comprising:

forming a second barrier metal layer on the first barrier metal layer before forming the upper conductive layer.

11. The method of Claim 10, wherein forming the second barrier metal layer comprises forming the second barrier metal layer using physical vapor deposition including sputtering.

12. The method of Claim 10, wherein the second barrier metal layer comprises titanium nitride, titanium silicon nitride, tantalum silicon nitride, and/or tantalum nitride.

13. The method of Claim 1, wherein forming the barrier metal layer comprises forming the barrier metal layer using atomic layer deposition.

14. The method of Claim 13, wherein forming the barrier metal layer using atomic layer deposition and flushing the barrier metal layer are performed at least twice.

15. The method of Claim 13, further comprising:

degassing the barrier metal layer before flushing the barrier metal layer.

16. The method of Claim 15, wherein forming the barrier metal layer using atomic layer deposition, degassing the barrier metal layer, and flushing the barrier metal layer are performed at least twice.

17. The method of Claim 15, wherein the barrier metal layer is a first barrier metal layer, the method further comprising:

forming a second barrier metal layer on the first barrier metal layer before forming the upper conductive layer.

18. The method of Claim 1, wherein the lower conductive pattern comprises tungsten, aluminum, polysilicon, copper, titanium, titanium nitride, tantalum, tantalum

silicon nitride, and/or tantalum nitride.

19. The method of Claim 1, wherein the barrier metal layer comprises titanium nitride, titanium silicon nitride, tantalum silicon nitride, and/or tantalum nitride.

20. The method of Claim 1, wherein forming the barrier metal layer comprises forming the barrier metal layer using chemical vapor deposition with a metal organic precursor.

21. The method of Claim 1, wherein the upper conductive layer comprises tungsten, aluminum, polysilicon, and/or copper.

22. The method of Claim 1, further comprising:

treating the barrier metal layer with plasma before flushing the barrier metal layer.

23. The method of Claim 1, wherein the plasma comprises a processing gas that comprises hydrogen and/or nitrogen.

24. A method of forming a conductive structure of a semiconductor device, comprising:

forming a lower conductive pattern on a semiconductor substrate;

depositing a barrier metal layer on the semiconductor substrate with the lower conductive pattern using a metal organic precursor;

flushing the deposited barrier metal layer; and

forming an upper conductive layer on the semiconductor substrate with the flushed barrier metal layer,

wherein the step of flushing the barrier metal layer uses a processing gas including $TiCl_4$ gas and argon gas.

25. The method of Claim 24, wherein the barrier metal layer comprises titanium nitride (TiN), titanium silicon nitride (TiSiN), tantalum silicon nitride (TaSiN) and/or tantalum nitride (TaN).

26. The method of Claim 24, wherein the metal organic precursor is TDEAT or TDMAT.

27. The method of Claim 24, wherein the barrier metal layer is formed using a metal organic chemical vapor deposition (MO-CVD) or an atomic layer deposition (ALD) process.

28. The method of Claim 27, wherein the ALD process comprises a purging process using nitrogen (N_2), hydrogen (H_2), ammonia (NH_3) and/or titan tetrachloride ($TiCl_4$) as a purging gas.

29. The method of Claim 24, wherein forming the barrier metal layer further comprises plasma treatment.

30. The method of Claim 29, wherein the plasma treatment uses a processing gas comprising nitrogen and/or hydrogen gases.

31. The method of Claim 24, further comprising degassing the barrier metal layer at an inert gas ambience before flushing the barrier metal layer,

wherein the degassing step is performed at a temperature of about 200°C to 500°C under a pressure of about 1 mTorr to 100 Torr.

32. The method of Claim 24, wherein flushing the barrier metal layer is performed at a temperature of about 200°C to 500°C.

33. The method of Claim 24, wherein the argon gas is provided with a flux of about 500sccm to 10000sccm, and the $TiCl_4$ gas is provided with a flux of about 1sccm to 100sccm.

34. The method of Claim 24, wherein flushing the barrier metal layer is performed under a pressure of about 1 torr to 100 torr.

35. The method of Claim 24, wherein flushing the barrier metal layer is performed for about 1sec to 10min.

36. The method of Claim 24, wherein the barrier metal layer is a first barrier metal layer, the method further comprising:

forming a second barrier metal layer after flushing the first barrier metal layer,

wherein the second barrier metal layer is formed using sputtering technology.

37. The method of Claim 36, wherein the second barrier metal layer comprises titanium nitride (TiN), titanium silicon nitride (TiSiN), tantalum silicon nitride (TaSiN) and/or tantalum nitride (TaN).

38. The method of Claim 24, wherein forming the barrier metal layer and flushing the barrier metal layer are repeated at least once.